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Environmental Determinants of Behavioral Intention to Adopt Electric Vehicles in Vietnam

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ABSTRACT

This research examines Vietnamese consumers' intention to adopt EVs by extending the Theory of Planned Behavior with three environmental variables: environmental knowledge, environmental concern, and environmental responsibility. A sample of 545 valid responses based on an online survey was analyzed and the research model was analyzed using structural equation modeling. The extended model explains 42.4% of the variance in behavioral intention, indicating a relatively strong explanatory power. The results show that environmental knowledge, environmental concern, and environmental responsibility significantly influence behavioral intention directly as well as indirectly via attitude, subjective norms, and perceived behavioral control. All core constructs of the Theory of Planned Behavior also exert positive effects on behavioral intention, with perceived behavioral control emerging as the strongest predictor ($\beta = 0.322$). These findings underscore the significance of incorporating environmental factors into models of behavior and offer practical implications for policymakers and promotors aiming to enhance sustainable mobility adoption.

Keywords: Electric Vehicles, Behavioral Intention, Theory of Planned Behavior, Environmental Factors, Sustainable Mobility
JEL Classifications: M31, Q56, D91

1. INTRODUCTION

The global energy demand and thus emissions contributing to climate change and air pollution continued to rise at an annual rate of approximately 2.2% in 2024 (IEA, 2025). Transportation also represents a significant share of emissions, approximately 9 $GtCO_2$ per year (Tiseo, 2025). Global efforts to address climate change, such as the United Nations Framework Convention on Climate Change (UNFCCC), have called for countries to decarbonize their economies and promote sustainable mobility. At COP29, UITP (2024) emphasized that the combined share of public transport and active mobility has to at least double in order to bring about a 50% reduction in transport emissions. Therefore, electric vehicles (EVs) may be considered a promising alternative to reduce the use of fossil energy and circumvent environmental degradation from burning fossil fuels (Neves et al., 2019). Developed countries are implementing "de-ICEing" policies to ban conventional vehicles in cities such as Copenhagen, Oslo, and Amsterdam (Ren and Jermain, 2019). Nonetheless, EV adoption worldwide is still quite low, highlighting an important gap in our understanding of consumer motivations and behavioral determinants despite increasing model availability or government incentives (Egbue and Long, 2012; Hardman, 2019).

Hanoi and Ho Chi Minh City are among the largest cities in Vietnam, facing some of the most severe urban air pollution in the world. According to Nguyen et al. (2024), Hanoi often experiences alarming levels of $PM_{2.5}$. Another pollution component is secondary inorganic aerosols (sulfate, ammonium, and nitrate), which are generated both locally and through long-range transport derived from local as well as long-distance transport of pollution, particularly from northern regions. In addition, the $PM_{2.5}$ in Ho Chi Minh City is still at life-threatening levels, with a yearly average figure of around 36.3 $\mu g/m^3$ recorded, far above both

national and WHO recommendations. $PM_{2.5}$ comes from traffic pollution during rush hours (To et al., 2019). These results demonstrate that major Vietnamese urban areas are challenged by severe air quality problems. After the energy sector, transport is the second largest source of greenhouse gas emissions in Vietnam. In 2023 the sector totaled approximately 39.3 million tonnes CO_2 (about 11% of the national total), with road transport accounting for 61–84%, depending on the subsector (Vietnam Ministry of Agriculture and Environment, 2025). Without stronger policy frameworks, transportation emissions could jeopardize Vietnam's goal of reaching net-zero emissions by 2050.

In this regard, EVs have become an effective solution as Vietnam seeks to reduce its dependence on fossil fuels and work toward carbon neutrality by 2050. The Vietnamese government has implemented several supportive policies, such as tax incentives, EV infrastructure development, and domestic manufacturing initiatives led by VinFast. However, beyond policy and technological readiness, psychological and environmental factors play a dominant role in determining consumer adoption of green products (Rahman et al., 2023). These determinants are thus essential for understanding in order to speed up Vietnam's transition toward sustainable mobility.

Although extensive research has highlighted the importance of environmental knowledge (EK), environmental concern (EC), and environmental responsibility (ER) in predicting pro-environmental and green purchase behaviors (Zeng et al., 2023; Rahman et al., 2023), empirical evidence in the EV adoption context is still emerging, with recent EV-specific studies mainly emphasizing environmental concern (Zhao et al., 2024). Most prior EV studies have treated these variables individually, emphasizing their separate effects rather than their combined impact. As a result, the interactive and mediating mechanisms among EK, EC, and ER in shaping behavioral intention remain unclear. Particularly in Vietnam, empirical research that simultaneously integrates EK, EC, and ER within a unified behavioral model is scarce. To address this gap, the present study adopts the Theory of Planned Behavior (TPB) as its conceptual foundation and incorporates the three environmental variables (EK, EC, and ER) into an extended behavioral framework. This integration allows for a more comprehensive analysis of how cognitive understanding, affective concern, and moral obligation jointly shape consumers' environmentally responsible decisions regarding EV adoption.

Extending prior environmental behavior research, this study examines how psychological factors mediate the effects of environmental knowledge, environmental concern and responsibility on Vietnamese consumers' intention to adopt EVs. It specifically considers how these environmental constructs interact with TPB factors (attitude, subjective norm and perceived behavioral control) to predict EV adoption intention. The study intends to demonstrate how environmental awareness and values are transformed into sustainable behavioral intentions by considering EK as a cognitive factor, EC as an affective factor and ER as a moral factor.

Accordingly, the study is guided by the following research questions:

- RQ1: How do environmental knowledge, environmental concern, and environmental responsibility influence Vietnamese consumers' intention to adopt electric vehicles?
- RQ2: Do environmental knowledge, environmental concern, and environmental responsibility affect behavioral intention directly or indirectly through the core constructs of the Theory of Planned Behavior?
- RQ3: To what extent does extending the Theory of Planned Behavior with environmental knowledge, environmental concern, and environmental responsibility improve the model's explanatory power for electric vehicle adoption intention?

This study is theoretically based on the TPB (Ajzen, 1991), in which behavioral intention is influenced by attitude toward the behavior, subjective norm, and perceived behavioral control. The model is elaborated by adding EK, EC, and ER as antecedent factors that shape these underlying elements. This extension is in line with the Value-Belief-Norm (VBN) theory (Stern et al., 1999) and the Norm Activation Model (NAM) (Schwartz, 1977), which emphasize a moral aspect of pro-environmental decision-making. As suggested by Saari et al. (2021) and Rahman et al. (2023), environmental knowledge is a cognitive impulse, and the more concern and responsibility individuals feel toward the environment, the stronger their intention to perform pro-environmental behavior. This framework incorporates both rational-cognitive and moral-normative components for EV adoption behavior in Vietnam.

The main objective of this study is to build and empirically test an extended TPB model which determines EV adoption intention as a function of the combined effects of EK, EC, and ER. Theoretically, it combines cognitive-rational and moral-normative perspectives to provide a comprehensive account of the psychological mechanisms underlying sustainable mobility behavior in Vietnam. Operationally, the results will be used to guide on-the-ground decisions of policymakers, educators and industry players in shaping environmental communication and marketing campaigns that serve to increase public awareness, emotional connectedness, and moral ownership regarding electric mobility. In conclusion, this work strives to instigate a change in behavior for sustainable travel demand and support the nation of Vietnam in climate change mitigation toward environmental sustainability.

2. CONCEPTUAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

2.1. The Theory of Planned Behavior

TPB provides a robust theoretical base to explain and predict individuals' intentions to adopt sustainable technologies such as EVs. In TPB the behavioral intention is determined by three main factors, namely, attitude toward the behavior, subjective norm and perceived behavioral control (Ajzen, 1991). These, in turn, refer to an individual's perception of how useful the behavior is, how important others would perceive their performance of the behavior to be, and how easy or difficult it would be to perform the behavior. TPB has long been successfully used in pro-environmental behavior and technology adoption research, particularly in studies

of EVs and hybrid vehicles (Han et al., 2010; Chen and Tung, 2014; Wang et al., 2016; Moon, 2020; García-Salirrosas et al., 2024; Zhai et al., 2025).

2.1.1. Attitude toward electric vehicle adoption

Attitude (ATT) is defined as a general positive or negative evaluation of a specific behavior (Ajzen, 1991). A positive attitude can be established among consumers toward the adoption of EVs when they believe that EVs provide environmental and functional benefits. For example, when individuals believe that the use of EVs can lead to a reduction in emissions and protect the environment, they tend to hold more favorable beliefs and stronger behavioral intentions to adopt EVs (Jansson, 2011; Noppers et al., 2014; Rezvani et al., 2015). Findings of empirical studies suggest that attitude is a strong predictor of purchase intentions toward eco-friendly cars and other green innovations (Paul et al., 2016; Mohamed et al., 2016; Moon, 2020; Tanwir and Hamzah, 2020; Varah et al., 2021; Cooraay et al., 2023). Accordingly, attitude is expected to positively influence consumers' behavioral intention to adopt EVs. Hence, the following hypothesis is proposed:

- H_1: Attitude toward electric vehicle adoption has a positive effect on behavioral intention to adopt electric vehicles.

2.1.2. Subjective norm

Subjective norm (SN) relates to the perception of social pressure from significant referent groups (such as family, friends, and colleagues) on performing or not doing a specific behavior (Ajzen, 1991). In the TPB, SN are influenced by two primary determinants: injunctive norms, and descriptive norms. Injunctive norms reflect individuals' perceptions of what significant others think they should do, representing moral or social expectations, whereas descriptive norms reflect perceptions of what others are actually doing, indicating commonly accepted behavior patterns (Cialdini et al., 1991; White et al., 2009). When individuals perceive that significant others approve of adopting eco-friendly vehicles or observe that people around them are already using such vehicles, they are more likely to intend to adopt EVs (Bockarjova and Steg, 2014). Previous studies have consistently demonstrated that social influence, including both injunctive and descriptive norms, plays a critical role in shaping consumers' pro-environmental intentions and adoption of EVs (Kaplan et al., 2016; Adnan et al., 2017; Shanmugavel and Balakrishnan, 2023; Zhai et al., 2025). Therefore, the following hypothesis is proposed:

- H_2: Subjective norm has a positive effect on behavioral intention to adopt electric vehicles.

2.1.3. Perceived Behavioral Control

Perceived behavioral control (PBC) is defined as the perceived ease or difficulty in performing a behavior, which includes both internal factors such as abilities and self-confidence, and external factors such as resources and opportunities (Ajzen, 1991; Taylor and Todd, 1995). In the case of EV adoption, individuals who perceive that they have enough financial capacity, technical knowledge or access to nearby charging facilities are more likely to have strong behavioral intentions. Conversely, if vehicle prices are high or infrastructure is lacking, a low level of perceived behavioral control reduces behavioral intention. Perceived behavioral control has been highlighted recently as one of the strongest predictors of electric vehicle adoption and other sustainable mobility behaviors (Wang et al., 2016; Tanwir and Hamzah, 2020; Shakeel, 2022; Yeğin and Ikram, 2022; García-Salirrosas et al., 2024). Thus, it is hypothesized that:

- H_3: Perceived behavioral control has a positive effect on behavioral intention to adopt electric vehicles.

2.2. Environmental Knowledge

Environmental knowledge (EK) is the factual, conceptual, and procedural knowledge that an individual has of environmental problems and solutions (Fryxell and Lo, 2003; Pagiaslis and Krontalis, 2014). For this reason, this knowledge equips people to relate the drivers and effects of environmental deterioration associated with traditional transportation modes (fueled by fossil energy) and the significance of cleaner and more sustainable mobility options (electric vehicles). Based on Social Cognitive Theory, cognition is a central determinant of behavioral responses, as individuals' knowledge and beliefs interact with affective reactions and environmental influences to guide their decision-making (Bandura, 1986). Consequently, those who are more knowledgeable about the environment have a more positive cognitive evaluation of environmental problems, and this also serves to intensify an individual's intention to adopt environmentally friendly technologies such as EVs. Therefore, environmental knowledge is a cognitive base that builds an emotional response to environmental problems: In other words, their environmental concern.

Evidence indicates that individuals with high levels of environmental knowledge tend to have a greater consciousness about the seriousness of environmental problems (such as air pollution and greenhouse gas emissions) and hence they express more concern toward protecting the environment (Gifford and Nilsson, 2014; Zeng et al., 2023). Regarding EV users, those who have a deep understanding of environmental benefits of electric vehicles, such as emission reductions and energy savings, are likely to have a stronger sense of environmental responsibility than others, leading to a stronger intention to adopt EVs. In addition, the cognitive aspect of environmental knowledge is an important determinant of attitudes toward the environment and behavioral intentions, indirectly influencing pro-environmental behavior (Paço and Lavrador, 2017; Gkargkavouzi et al., 2019). Therefore, environmental concern may function as a result of what individuals learn and know about environmental issues and sustainable forms of mobility, implying that knowledge serves as a critical cognitive mechanism for the affective and behavioral transformation in EV adoption.

- H_{4a}: Environmental knowledge has a positive effect on environmental concern.

Environmental knowledge not only shapes individuals' environmental attitudes but also reinforces their sense of environmental responsibility. Individuals with higher environmental knowledge are more capable of assessing the ecological consequences of their actions and, therefore, tend to feel more accountable for protecting the environment (Kim and Stepchenkova, 2018). Drawing on the Value-Belief-Norm (VBN) theory, Liobikienė and Poškus (2019) emphasized that

environmental knowledge strengthens individuals' beliefs about the outcomes of environmental issues, which subsequently activates personal moral norms, an essential component of environmental responsibility. Among the various forms of knowledge, action-related knowledge, which concerns knowing how to carry out effective pro-environmental actions, exerts the strongest influence on private-sphere pro-environmental behavior, suggesting that knowledgeable individuals are more likely to internalize a moral duty to protect the environment.

Empirical studies have consistently shown that environmental knowledge is a key factor in cultivating personal moral responsibility and sense of obligation to protecting the natural world. People with more environmental knowledge are better able to understand the repercussions of environmental destruction, thus increasing their moral responsibility perception and encouraging them to engage in environmentally responsible behaviors, through mechanisms such as moral elevation (Ye et al., 2022). Similarly, Keles et al. (2023) have confirmed that individuals endowed with environmental knowledge tend to be more environmentally responsible, and this effect is stronger for those who have higher environmental commitment levels. Taken together, these results indicate that environmental knowledge is a cognitive, and therefore moral, foundation of eco-responsibility.

Applying the same reasoning to sustainable transportation, people with little knowledge of the environment are less aware of the negative impacts of fuel-based vehicles and benefits of EVs. This knowledge nurtures a heightened sense of obligation to reduce environmental damage and thus increases the intention to use EVs as an environmentally responsible alternative.

- H_{4b}: Environmental knowledge has a positive effect on environmental responsibility.

2.3. Environmental Responsibility

Environmental responsibility (ER) refers to an individual's inclination and motivation in adopting behaviors aimed at protecting the environment, emphasising social and environmental well-being (Stone et al., 1995; Jovanović et al., 2015). People with a sense of environmental obligation were found to engage in pro-environmental behaviors (Han, 2021). This holds true for tourism and hospitality, where environmentally responsible individuals tend to select environmentally friendly services and patronize sustainable operations. Theoretically, in the context of electric vehicle adoption, specifically individuals with high levels of environmental responsibility are more likely to view EVs as an environmentally friendly substitute for conventional gasoline vehicles and thus generate higher levels of intention for their adoption. Empirical studies have shown that environmental responsibility motivates consumers to devote their attention toward environmentally sound choices, such as purchasing green products and practicing sustainable consumption (Follows and Jobber, 2000; Kumar and Ghodeswar, 2015). Furthermore, environmental responsibility has been recognized as one of the main drivers motivating pro-environmental behavior within private consumption categories such as energy conservation and green product use (Liobikienė and Poškus, 2019). Since it is generally agreed that EVs are considered environmentally friendly products which can cut CO2 emissions and air pollution, the consumers who have strong environmental responsibility will be more likely to accept them for their contribution toward environmental protection. It is thus hypothesized that individuals with high environmental responsibility should have higher behavioral intentions to use EVs.

- H_5: Environmental responsibility has a positive effect on behavioral intention to adopt electric vehicles.

2.4. Environmental Concern

Environmental concern (EC) represents individuals' overall consciousness and value systems regarding the environment (Vainio and Paloniemi, 2014; Franzen and Meyer, 2010). While environmental concern is generally viewed as a precursor to attitudes, prior research suggests that it may exert a particularly strong indirect effect on specific behaviors, such as the adoption of EVs, through mediators including attitudes and intentions (Bamberg, 2003; Minton and Rose, 1997). In line with the TPB (Ajzen, 1991), environmental concern is expected to influence intention through three core constructs: attitude toward behavior, subjective norm, and perceived behavioral control.

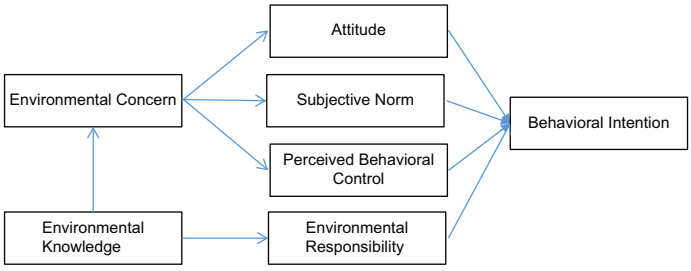
This mediating factor is consistent with empirical evidence, as Mohamed et al. (2016) revealed that environmental concern has a significant indirect impact on EV adoption intention via attitude, subjective norm, and perceived behavioral control, while its direct effect is non-significant. Similarly, Mohamed et al. (2018) demonstrated that attitude and perceived behavioral control best predict EV acceptance intention, with environmental concern serving as a deeper underlying motivational determinant of these beliefs. These results are consistent with those reported by Wang et al. (2016), who found that the environmental concerns of consumers further contribute to their positive attitudes toward EVs, perceived social norms and perceived behavioral control regarding EV use.

In this context, the higher the level of environmental concern is, the more positive attitude, subjective norm, and perceived behavioral control toward EV adoption are likely to become, subsequently strengthening intentions to adopt electric vehicles.

Therefore, the following hypotheses are proposed (Figure 1):

- H_{6a}: Environmental concern has an indirect positive effect on behavioral intention to adopt electric vehicles through attitude.
- H_{6b}: Environmental concern has an indirect positive effect on behavioral intention to adopt electric vehicles through subjective norm.

Figure 1: Theoretical framework



Source: Developed by the author

- H_{6c}: Environmental concern has an indirect positive effect on behavioral intention to adopt electric vehicles through perceived behavioral control.

3. RESEARCH METHODOLOGY

3.1. Scales

To operationalize the research model, validated measurement scales were adapted from prior studies and refined to fit the objectives of this study. The measurement items for attitude (ATT), subjective norm (SN), perceived behavioral control (PBC), and behavioral intention (BI) were adapted from established TPB scales developed in prior studies (Paul et al., 2016; Wang et al., 2016; Buhmann et al., 2024), with minor modifications made by the author to ensure their relevance to the electric vehicle (EV) adoption context. The final scales consisted of four items for ATT, five items for SN, four items for PBC, and three items for BI.

The environmental constructs were adapted from validated scales in previous research. Specifically, the environmental concern (EC) and environmental responsibility (ER) scales were adapted from Hamzah and Tanwir (2021), while the environmental knowledge (EK) scale was adapted and modified from Mostafa (2007). The EK construct was measured using five items, whereas both EC and ER were measured using four items each, capturing respondents' levels of environmental concern, knowledge, and perceived responsibility toward environmental protection. The wording of all items was carefully revised to ensure conceptual clarity and consistency with the EV adoption domain.

All measurement items were then refined and translated to ensure conceptual equivalence, contextual relevance, and cultural suitability of the items for the Vietnamese context. All constructs were assessed on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.2. Methods

A non-probability sampling technique combining convenience and purposive sampling was used. This study targeted consumers aged 18 years or older who had at least heard of green cars, mainly including electric vehicles (EVs). The online questionnaire was created using Google Forms and distributed through selected Facebook community groups related to transportation, environmental issues, and green technologies. The data collection spanned 8 weeks, with 608 responses. After removing incomplete or invalid responses, a final sample of 545 valid responses was retained.

According to Hair et al. (2010), the sample size for SEM is recommended as being five to ten times higher than number of observed variables. This study also consisted of 29 observed variables, which suggests that the sample size needed would be in the range between 145 and 290. Based on an empirical sample size of 545, the study met the recommended requirements and was appropriate for SEM estimation. The demographic details of the respondents are summarized in Table 1.

Table 1: Demographic characteristics of respondents

Sample profile	Frequency (n)	Percentage
Gender		
Male	343	62.94
Female	202	37.06
Age		
≤20 years old	17	3.12
21-30 years old	168	30.83
31-40 years old	214	39.27
41-50 years old	83	15.23
51-60 years old	36	6.61
>60 years old	27	4.95
Educational Level		
High School	37	6.79
College	75	13.76
Bachelor's Degree	298	54.68
Postgraduate	135	24.77
Income (per month)		
<10 million VND	38	7.00
10-20 million VND	112	20.60
20-40 million VND	184	33.80
40-60 million VND	118	21.70
60-80 million VND	54	9.90
80-100 million VND	26	4.80
≥100 million VND	13	2.40

Source: Developed by the author

3.3. Data Analysis Method

The dataset was cleaned, coded, and prepared for statistical analysis. PLS-SEM was performed using SmartPLS 3.0 to test the measurement and structural models based on Hair et al. (2019). We selected this approach because it is applicable for complex models with multiple constructs and can accommodate non-normal data distributions.

First stage: The measurement model. The measurement model was examined to assess the reliability and validity of the constructs. Internal consistency reliability was evaluated using Cronbach's alpha and composite reliability (CR), with a cut-off point of 0.70. Convergent validity was examined using the average variance extracted (AVE), which should be higher than 0.50. Several criteria were used to examine discriminant validity by (1) the Fornell–Larcker criterion, where the square root of AVE values for each factor is higher than its correlations with other constructs and (2) the heterotrait–monotrait (HTMT) ratio should be lower than 0.85 as suggested by Henseler et al. (2015).

In the second stage, the structural model was tested to evaluate the research hypotheses and the relationships among the latent variables influencing consumers' intention to adopt electric vehicles (EVs). The evaluation included path coefficients and the coefficient of determination (R^2), which reflects the explanatory power of the independent variables on dependent variable. In addition, indirect effects were examined to assess potential mediating relationships among constructs. Bootstrapping with 5,000 resamples was performed to determine the statistical significance of both direct and indirect path coefficients.

4. STUDY OUTCOMES

4.1. Multicollinearity Test

Before analyzing the structural model, a multicollinearity test was conducted for the independent variables using variance inflation factor (VIF) values. As shown in Table 2, the results indicated that all VIF values are in the range from 1.008 to 1.049, well below the threshold of 5, suggesting that there was no serious multicollinearity problem in the model (Hair et al., 2019).

4.2. Scale Reliability Test

The internal reliability and convergent validity of the measurement scales were assessed by considering three key indicators: Cronbach's alpha (CA), CR, and average variance extracted (AVE). According to Hair et al. (2019), a construct is internally consistent if both CA and CR are greater than 0.70, while convergent validity is present when AVE exceeds 0.50. In Table 3, all scales show that the results comply with these cutoffs, because values of CA and CR are above 0.70 and AVE is greater than 0.50. These results indicate that all constructs in this study demonstrate acceptable internal consistency and convergent validity, supporting the extent to which the observed measures adequately represent their underlying latent constructs.

In relation to discriminant validity, the study used the heterotrait–monotrait (HTMT) ratio of correlations proposed by Henseler et al. (2015). This method has been shown to outperform the conventional Fornell–Larcker criterion for assessing a failure to exhibit discriminant validity. Under the recommended threshold, discriminant validity is established when HTMT values between any two constructs are less than 0.85. As reported in Table 4, all HTMT statistics are below this threshold, implying that the constructs in our measurement model are empirically distinct and do not suffer from substantial conceptual redundancy.

4.3. Structural Model Assessment

The explanatory power of the model and the significance of the hypothesized relationships were tested through a structural equation modeling (SEM) approach. As can be seen from the results, the R^2 value for BI is 0.424, which indicates that ATT, SN, PBC, EK, EC and ER collectively explain 42.4% of the variation in consumers' intention towards adopting EVs. According to Hair et al. (2019), this is a moderate explanatory power, suggesting that the model developed provides meaningful insights into consumers' behavioral intent toward EVs. The structural model results are presented in Figure 2.

Bootstrapping results with 5,000 resamples (Table 5) show that each hypothesized direct effect is significant (P = 0.000). ATT of electric vehicle adoption has a positive and significant effect on BI (β = 0.237, P = 0.000), while SN (β = 0.305, P = 0.000) and PBC (β = 0.322, P = 0.000) also positively affect BI. ER is also significantly positively related to BI (β = 0.297, P = 0.000), indicating it is a moral determinant of pro-environmental behavior.

In addition, EK positively influences both EC (β = 0.289, P = 0.000) and ER (β = 0.26, P = 0.000), indicating its cognitive effect on environmental attitude as well as moral obligation. However, EC significantly and positively influences ATT (β = 0.303, P = 0.000), SN (β = 0.342, P = 0.000), and PBC (β = 0.365, P = 0.000) indicating a significant positive effect. Taken together, these results verify EK, EC, and ER as antecedents that jointly contribute to promote consumers' attitudes, subjective norm, perceived behavioral control, and adoption intention toward

Table 2: Multicollinearity diagnostics

	ATT	BI	EC	EK	ER	PBC	SN
ATT		1.016					
BI							
EC	1.000					1.000	1.000
EK			1.000		1.000		
ER		1.008					
PBC		1.049					
SN		1.045					

Source: Developed by the author

Table 3: Reliability and validity of constructs

Constructs	Item	Loadings	Cronbach's α	CR	AVE
Attitude	ATT1	0.956	0.882	0.919	0.742
	ATT2	0.758			
	ATT3	0.849			
	ATT4	0.871			
Subjective Norm	SN1	0.951	0.881	0.906	0.68
	SN2	0.862			
	SN3	0.756			
	SN4	0.757			
	SN5	0.783			
Perceived Behavioral Control	PBC1	0.956	0.89	0.915	0.755
	PBC2	0.814			
	PBC3	0.808			
	PBC4	0.888			
Environmental Knowledge	EK1	0.939	0.871	0.882	0.664
	EK2	0.795			
	EK3	0.759			
	EK4	0.797			
	EK5	0.77			
Environmental Concern	EC1	0.944	0.863	0.868	0.712
	EC2	0.772			
	EC3	0.815			
	EC4	0.836			
Environmental Responsibility	ER1	0.946	0.871	0.897	0.723
	ER2	0.862			
	ER3	0.78			
	ER4	0.803			
Behavioral Intention	BI1	0.948	0.851	0.895	0.772
	BI2	0.897			
	BI3	0.783			

Source: Developed by the author

Table 4: HTMT values of constructs

Constructs	EK	EC	ER	ATT	SN	PBC	BI
EK							
EC	0.331						
ER	0.289	0.135					
ATT	0.092	0.34	0.054				
SN	0.126	0.384	0.035	0.101			
PBC	0.108	0.414	0.084	0.103	0.207		
BI	0.195	0.42	0.37	0.346	0.428	0.472	

Source: Developed by the author

Table 5: Results of hypothesis testing

Hypothesies	Relationship	Path coefficient	Standard deviation	T statistics	P values	Result
H_1	ATT→BI	0.237	0.031	7.526	0.000	Supported
H_2	SN→BI	0.305	0.032	9.585	0.000	Supported
H_3	PBC→BI	0.322	0.031	10.348	0.000	Supported
H_{4a}	EK→EC	0.289	0.038	7.608	0.000	Supported
H_{4b}	EK→ER	0.26	0.038	6.889	0.000	Supported
H_5	ER→BI	0.297	0.032	9.381	0.000	Supported
H_{6a}	EC→ATT	0.303	0.038	8.038	0.000	Supported
H_{6b}	EC→SN	0.342	0.036	9.382	0.000	Supported
H_{6c}	EC→PBC	0.365	0.036	10.063	0.000	Supported

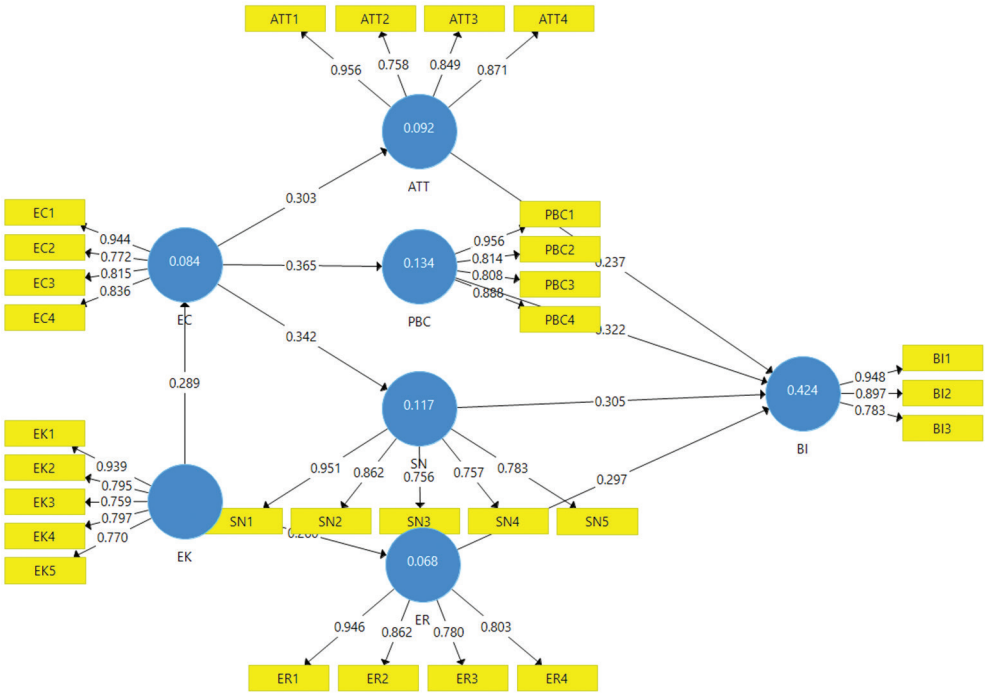
Source: Developed by the author

Table 6: Results of indirect effects testing

Relationship	Path coefficient	Standard deviation	T statistics	P values	Result
EK→EC→ATT	0.088	0.016	5.347	0.000	Supported
EC→ATT→BI	0.072	0.014	5.27	0.000	Supported
EK→EC→ATT→BI	0.021	0.005	4.197	0.000	Supported
EK→ER→BI	0.077	0.014	5.382	0.000	Supported
EC→PBC→BI	0.118	0.017	7.017	0.000	Supported
EK→EC→PBC→BI	0.034	0.007	4.938	0.000	Supported
EC→SN→BI	0.104	0.016	6.36	0.000	Supported
EK→EC→SN→BI	0.03	0.007	4.583	0.000	Supported
EK→EC→PBC	0.106	0.018	5.837	0.000	Supported
EK→EC→SN	0.099	0.018	5.436	0.000	Supported

Source: Developed by the author

Figure 2: Structural model results



Source: Developed by the author

EVs.

Apart from the direct effects of TPB, indirect relationships were also tested to examine the mediating processes among the extended TPB factors. The standardized indirect effects were tested for significance, and most paths exhibited meaningful mediation. Table 6 shows that most indirect relationships between environmental variables and behavioral intention are significant (P = 0.000), indicating that environmental factors have significant indirect effects. In particular, EK influences BI indirectly through EC and ER, as well as the TPB variables (ATT, SN, and PBC). Similarly, EC serves as a mediating factor affecting ATT, SN, and PBC, which in turn enhance BI.

Overall, these findings confirm the existence of multi-level mediation effects, demonstrating that environmental cognition and moral responsibility indirectly foster pro-environmental attitudes, social influence, and perceived control, key determinants that ultimately drive consumers' intention to adopt EVs, thereby reinforcing the explanatory relevance of the extended TPB in the context of EV adoption.

5. DISCUSSION

The findings demonstrated that all the original constructs of the TPB, attitude (ATT), subjective norm (SN), and perceived behavioral control (PBC) had positive and significant impacts on behavioral intention (BI), in line with the theoretical predictions of the TPB. Among these predictors, PBC had the greatest impact on BI, meaning that people who believe in their financial ability to purchase and maintain an EV, as well as having access to charging facilities and sufficient technical knowledge, are more likely to have a stronger intention to adopt EVs. The ATT finding suggests that the perceived benefits of EVs, such as cost-effectiveness, performance, and environmental advantages, are significant determinants shaping consumers' attitudes toward EV adoption. Moreover, the strong effect of SN highlights that social influence plays a major role: family, friends, and societal expectations encourage individuals to engage in environmentally friendly actions such as adopting EVs. These results are consistent with existing studies (Buhmann et al., 2024; Shalender and Sharma, 2020; Wang et al., 2016), which suggest that psychological predictors remain the most influential determinants of behavioral intention in the context of sustainable mobility.

In the Vietnamese context, this observation is particularly pertinent given the rising demand for private car use along with strong government support for electric mobility. Other psychological factors, such as attitude, perceived control, and subjective norm, are also crucial in transforming support for a given policy into actual adoption by consumers. In addition to the TPB variables, environmental factors also contributed significantly to explaining behavioral intention. In particular, environmental knowledge shows a significant positive influence on both environmental concern (EC) and environmental responsibility (ER).This indicates that people who are better informed about environmental issues tend to be more concerned about ecological problems and feel a stronger personal responsibility toward biodiversity conservation. This result is consistent with previous studies (Frick et al., 2004; Fryxell and Lo, 2003; Bamberg and Möser, 2007; Saari et al., 2021), all of which highlight the role of environmental awareness in motivating individuals to act in ways that protect the environment. Similarly, studies by Ellen et al. (1991), Kollmuss and Agyeman (2002), Mostafa (2007), and Zsóka et al. (2013) showed that higher levels of ecological knowledge strengthen individuals' sense of moral obligation and responsibility toward environmental protection. Recent empirical evidence also supports this linkage, showing that both subjective and objective aspects of environmental knowledge significantly enhance environmentally responsible behavior by promoting greater awareness of moral obligations and responsibilities toward environmental protection (Guo et al., 2025).

In addition, EC positively and significantly influenced ATT, SN, and PBC, with the strongest effect observed on PBC. This suggests that individuals with higher environmental concern tend to have more positive attitudes toward EVs, perceive stronger social pressure, and feel more confident in their ability to adopt environmentally friendly vehicles. These findings are consistent with Paul et al. (2016), Wang et al. (2016), and Mohamed et al. (2016), further supporting the role of environmental concern in shaping behavioral intention through the psychological mechanisms of the TPB.

Finally, ER had a direct and positive influence on BI, indicating that an individual's sense of moral obligation and responsibility for environmental conservation is particularly motivating in encouraging green purchasing behavior. This result is consistent with Hamzah and Tanwir (2021), who argued that ER acts as an internalized moral norm that directly influences pro-environmental intentions and behavior. Likewise, Shanmugavel and Balakrishnan (2023) revealed that ER plays a pivotal role as an ethical construct within the extended TPB model, positively impacting consumers' EV adoption intention. Consistent with this, Alhamad et al. (2023) argued that personal ethical responsibility not only motivates people to act in accordance with their attitudes but also helps reduce the attitude–behavior gap by encouraging behaviors in which their environmental awareness is manifested, such as shifting from traditional gasoline-fueled cars to electric vehicles. Furthermore, Rahman et al. (2023) confirmed that ER has a statistically significant positive influence on consumers' green purchase intention, indicating that people who have a moral sense of responsibility toward solving environmental problems may be more likely to adopt sustainable consumption practices. Taken together, these findings emphasize the importance of ethical and moral factors in supplementing cognitive and social drivers that underpin consumers' adoption of eco-friendly technologies like EVs. The addition of environmental constructs such as ER to TPB extends its explanatory potential and provides a better understanding of consumer behavior toward sustainable transportation.

In Vietnam, which has witnessed the increase of environmental consciousness but has not yet achieved substantial EV adoption, these findings suggest that moral responsibility and environmental attitudes are effective tools for shaping consumer behavior. Boosting environmental education, promoting pro-environmental social norms, and focusing on moral aspects of sustainability could support public participation in Vietnam's movement toward low-emission mobility.

6. CONCLUSION AND IMPLICATIONS

Specifically, the current study incorporated environmental factors that included environmental knowledge, environmental concern and environmental responsibility into the TPB to understand the determinants of consumers' intentions toward EV adoption in Vietnam. The findings showed that three TPB constructs (attitude, subjective norm and perceived behavioral control) all significantly predicted behavioral intention, with perceived behavioral control being the most significant predictor. Moreover,

environmental knowledge had a significant positive impact on both environmental concern and environmental responsibility. In turn, environmental concern positively influenced ATT, SN, and PBC, while environmental responsibility showed a direct effect on BI. These results confirm that determinants from both psychological and environmental perspectives interact in shaping consumers' environmentally responsible behavior.

6.1. Theoretical Implications

This research contributes to the sustainable consumer behavior literature by extending the TPB framework with environmental constructs. By demonstrating how environmental knowledge, concern, and responsibility collectively influence behavioral intention, the study advances the understanding of the TPB framework in relation to cognitive, affective, and moral mechanisms. It also highlights that incorporating moral values and environmental concern enhances the model's predictive power in explaining green technology adoption. In addition, incorporating environmental constructs serves as a conceptual bridge between pro-environmental psychology and behavioral intention models, and may support future theoretical developments in sustainable mobility research.

6.2. Practical Implications

On a practical level, the results of our analysis can provide policymakers, environmental groups, and electric vehicle companies with valuable guidance. To promote EV adoption, stakeholders should develop education and communication programs that enhance environmental awareness and strengthen individuals' sense of personal responsibility for environmental protection. Marketing communications that emphasize both the environmental and cost-saving benefits of EVs could make positive attitudes toward EVs even stronger. Furthermore, infrastructure development, financial incentives, and reduced ownership barriers can increase consumers perceived behavioral control toward EV adoption. Collaboration between government and industry can help drive the transition toward cleaner and more sustainable transportation systems.

When applied to Vietnam, where the electric vehicle market is still emerging, these conclusions become particularly relevant. Key factors in promoting public acceptance of EVs include expanding the public charging infrastructure, offering tax deductions or purchase subsidies, and integrating environmental education into national communication campaigns. Furthermore, local manufacturers such as VinFast can apply these insights in their marketing and policy cooperation by emphasizing the social and environmental value of EVs, thereby supporting Vietnam's national commitment to achieving net-zero emissions.

6.3. Limitations and Future Research Directions

Despite its valuable findings, this study has several limitations. The research focused on behavioral and psychological determinants but did not include broader contextual factors such as policy environments and the availability of infrastructure, which may facilitate adoption in some regions but hinder it in others. One area for future study is the moderating role of environmental policy perception, technology-readiness and cultural orientation on consumer EV adoption. Furthermore, investigating differences between different kinds of electric vehicles would give a more detailed picture on how contextual factors and infrastructure influence sustainable mobility intentions.

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